Summer 8-3-2017

# LABEL POSITION AND ITS IMPACT ON WILLINGNESS TO PAY FOR PRODUCTS CONTAINING GENETICALLY MODIFIED ORGANISMS

Ruskin Gautam
*University of Nebraska - Lincoln*, rusking86@gmail.com

# LABEL POSITION AND ITS IMPACT ON WILLINGNESS TO PAY FOR PRODUCTS CONTAINING GENETICALLY MODIFIED ORGANISMS

by

Ruskin Gautam

A THESIS

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Master of Science

Major: Agricultural Economics

Under the Supervision of

Professors Kathleen Brooks and Christopher Gustafson

Lincoln, Nebraska

August 2017

# LABEL POSITION AND ITS IMPACT ON WILLINGNESS TO PAY FOR PRODUCTS CONTAINING GENETICALLY MODIFIED ORGANISMS

Ruskin Gautam, M.S.

University of Nebraska, 2017

Advisor: Kathleen Brooks and Christopher Gustafson

Food labels play an important role in communicating information. Labels provide information about production techniques, nutrition and ingredient information, and quality of a product (i.e. federal grade standards for eggs, U.S.D.A. quality grades on beef and pork). These are some of the key product attributes that consumers seek while making purchasing decisions. However, labels can be confusing and misleading and at times consumers simply ignore them. Research on the placement and effectiveness of labels conducted over the past few decades have found that information on the label influences buying habits. Food manufacturers could strategically use or place such attributes of labels to signal quality, shroud information or to influence the overall demand for the products.

Recent legislation on mandatory labeling of foods containing genetically modified (GM) ingredients provides information about GM ingredients through Internet or toll-free telephone numbers. However, accessing information through such mediums could increase search costs for consumers and allows firms to hide information about GM products. This goes against the original stated motivation for mandatory GM labeling—to provide transparency in food labels.

In this research an experimental auction was conducted to determine consumers' willingness to pay (WTP) for GM foods by placing GM information either on the front or the back label of food products to determine whether the position of the information affected consumer choices. Participants stated their WTP for twelve food items in a total of six rounds; within each round they examined and bid on two similar products, one containing GM ingredients and the other free of GM ingredients.

No significant differences in WTP were found between front and back labeled products. Also, we analyzed participants' characteristics to measure the effect on WTP, and we found several of the participant characteristics to have significant impacts on WTP.

**ACKNOWLEDGMENTS**

I would first like to thank my thesis advisors Dr. Kathleen Brooks and Dr. Christopher Gustafson for the time and support they gave me throughout my master's program. They were always there whenever I ran into a trouble or had a question about the research and coursework. They have always steered me to right direction whenever needed and I am truly honored to work under their direct supervision.

I would like to express my special gratitude to Dr. Kate Brooks for providing me the financial support by hiring me as her research assistant, which gave me an opportunity to explore the new areas in Agricultural Economics.

I would also like to thank all the faculty members and the staff from the Department of Agricultural Economics of UNL. The courses materials have provided valuable lessons that would be useful throughout my career. The staff from this department has been very supporting whenever I ran into different problems.

Last but not the least, I must express my very profound gratitude to my parents living in Nepal and to my loving wife Shrijana Khadka, and to my dear friend Raja Karki for providing me with unfailing support and continuous encouragement throughout the process of researching and writing this thesis. This accomplishment would not have been possible without them.

# TABLE OF CONTENTS

# CHAPTER 1: INTRODUCTION

## 1.1 Background

Labels are used as informational tools to confirm production techniques and provide quality signals. Food labels deliver information on external (size, shape, flavor, texture, grade) and internal (chemical, physical) characteristics of food, critical information consumers use to make purchasing decisions (Katarzyna et al. 2010; Ollberding, Wolf, and Contento 2010; Godwin et al. 2006), resolving the problem that consumers cannot evaluate many important product attributes before purchase. For some goods, often referred to as experience goods[1], consumers are able to learn about the product attributes when they consume the good (Nelson, 1970). For other goods, they may not be able to detect the presence of certain attributes, even if they have had the opportunity to consume the food product. These goods are known as credence goods (Darby and Karni, 1973). The inability of consumers to judge the quality of these goods leads to problems of informational asymmetry between the producer and the consumer. Animal welfare attributes, organic production, and the presence of genetically modified (GM) ingredients are all examples of credence attributes.

Consumers use different types of labels to access information on nutritional and ingredient content (Grunert et al. 2010; Campos, Doxey and Hammond 2011), the presence of materials that cause food allergies or other dietary issues (Mackinson, Wrieden and Anderson 2010; Petrovici et al. 2012, Cookie and Papadaki 2014), production methods and techniques (i.e. organic, animal-friendly, hormone-free, etc.),

[1] Experience goods are products and services whose value can only be truly determined by consuming or experiencing them.

and product quality (i.e. federal grade standards for eggs, U.S.D.A. quality grades on beef and pork) (Walters and Long 2012). In addition, research has found that nutrition information on food packages has improved consumers' food choices (Driskell, Schake, and Detter 2008), helping them adopt healthier eating habits (Nayga et al. 2006, Grunert and Wills 2007, Feunekes et al 2008). Labels, however, can be confusing, and may mislead consumers (Hawley et al. 2012), or they may simply be overlooked (Bialkova, Grunert and Van Trijp 2013; Cantor et al. 2015). Research has been conducted to identify attributes, such as color, label placement, or imagery, that increase the effectiveness of labels in communicating information that is useful for consumer choices (Graham, Orquin and Visschers 2012; Graham, Heidrick and Hodgin 2015; Hodgkins et al. 2012), finding, for instance, that front labels are more effective in communicating information than back labels. Color, another prominent attribute of the labels, also shapes consumer-purchasing behavior. Schuldt (2013) observed that green labels were viewed as healthy. Huang and Lu (2015) found that blue and green colored packages were considered to be healthy, whereas red packages were considered sweeter. The upshot is that these same attributes that increase consumers' attention may be omitted strategically by food manufacturers or policy makers to decrease the probability that consumers see or pay attention to product information that firms are required by law to provide, but which may decrease the likelihood that consumers select their product.

Recent legislation mandating the labeling of genetically modified foods illustrates this problem. The U.S. Federal Government passed a bill (U.S. Congress, 2016) in 2016, which supersedes existing state laws on the issue. The United States Department of

Agriculture (USDA) is given two years of time to develop guidelines and establish national labeling standards for GMOs (USDA Agricultural Marketing Service, 2016). The new federal law requires companies to provide access to information about GM ingredients in their products by printing text, a symbol, toll-free telephone numbers or QR codes on product packaging. Prior to this law, Vermont passed a bill in 2014 mandating the labeling of GM foods—effective July 2016—which required foods containing GM ingredients to be labeled if they were produced or partially produced with ingredients created through "genetic engineering" (State of Vermont State, 2013). Other state-level initiatives were proposed but failed (Proposition 37 in California in 2012 and Initiative 522 in Washington, 2013). Food manufacturers selling in the Vermont market had begun providing GM information in ingredient lists on foods distributed nationally in July 2016. General Mills, a major food producer, began placing labels on food products that contained GM ingredients (Baertlein, Maler, and Lewis 2016). Other major food companies such as ConAgra Foods, Kellogg's, Mars Inc., and Campbell's Soup began to disclose if their products contained GM ingredients (Osterman and Penmudi 2016). Therefore, for a brief period of time prior to the U.S. federal law, consumers already had access to GM information on some processed foods, though there is no evidence to what extent consumers were aware of this.

The mandatory labeling law in Vermont gave producers the latitude to indicate the presence of GM content on any side of the product. The federal legislation introduces a potential separate barrier to acquisition of information by giving firms the opportunity to require consumers to make a telephone call or to access the Internet in order to determine

whether a product contains GM ingredients. Federal laws on GMOs may increase search costs since consumers have to perform additional tasks to obtain information, and also contravene the principles of providing full information to consumers that proponents of legislation requiring GM labeling desired. Different issues related to GM technology and GM labels have been discussed for two decades, yet there is little evidence collected about consumers' choices in real-world—rather than experimental—settings to determine the impact of GM food labels on consumer behavior. Therefore, in this study we aimed to determine the impact of label placement on consumer food valuation.

### 1.2. Objectives

The overall objectives of this research are to 1) to evaluate the effects of information placement on consumer product valuation, and 2) to determine the impact of consumers' characteristics on willingness to pay (WTP). We achieve the first goal by examining consumers' valuation of food items with front or back labels compared to no labels in an experimental auction based on the Becker-DeGroot-Marschak (BDM) mechanism when that information is provided on the front of the package rather than the back of the package under natural information search conditions. We address the second goal by analyzing various consumers' characteristics collected from the survey.

# CHAPTER 2: LITERATURE REVIEW

GM crop cultivation has been increasing at an average annual rate of 4% around the world, involving 18 million farmers in 28 countries (James 2015). As of 2015, almost 444 million acres worldwide and 175.2 million acres in the United States were planted with varieties of GM crops (James, 2015). The United States remains the world's largest producer, harvesting about 43% of all GM crops (Hallman, Cuite, and Morin 2013). Food produced with GM technology has been available in U.S. grocery stores since 1996, yet consumers have not had direct access to information on whether or not the products contain GM ingredients. Under such circumstances, different groups advocating for mandatory GM labels insisted that consumers had a right to information about whether the food products they were consuming contained GM ingredients (see, for example, Non-GMO Project (2016a), Just Label It, 2017), while some started different state-level initiatives as described earlier. These organizations pushed for voluntary labeling laws and succeeded in developing labels indicating the absence of GM products, for instance "Non-GMO Verified," based upon verification tests and certain standards (Non-GMO Project, 2016b).

A significant amount of research has shown that some consumers are concerned about GM foods while others have accepted GM technology in food (Huang et al. 2006, Onyango et al. 2003; Onyango and Govindasamy 2004). Activist groups opposing genetically modified organisms (GMOs) argue that consumers have a right to information—that there should be transparency in food labels. Others argue against the use of GM technology in food because of potential allergic responses, effects on personal

health, and environmental impacts (Bawa and Anilakumar 2013). Advocates of GMOs argue that if GM food were unsafe, the Food and Drug Administration would not allow it to be sold in the market (Domingo and Bordonaba 2011; Nicolia et al. 2013). Research shows that GM technology could potentially reduce the cost of production (Bennett et al. 2013), improve the quality of products by enriching nutritional values (Zhao et al. 2015), and contribute to environmental sustainability (Levidow and Boschert 2008). Moreover, in developing countries GMOs have decreased deforestation for arable land because of higher crop yield and have tackled the problem of hunger and malnutrition (Zhang, Wohlhueter, and Zhang 2016).

Researchers investigated the linkages between education, information on GM products, knowledge about GM, and consumer attitudes towards GM (Wunderlich and Gatto 2015; McFadden and Lusk 2016). Studies conducted on consumers' attitudes and perceptions of GM show consumers value enhanced nutrition (Colson and Huffman 2011) and are less likely to oppose GM food if there are no environmental or health risks (Sebastian-Ponce, Sanz-Valero, and Wanden-Berghe 2014). Consumers with no knowledge or little knowledge about GM technology were more concerned about health-related risks from GM food consumption (Montuori, Triassi, and Sarnacchiaro 2012), whereas consumers with knowledge of GM products showed more positive attitudes towards GM technology (Teisl, Fein, and Levy 2009; Costa-Font and Mossailos 2005; Saher, Lindeman, and Hursti 2006). Moreover, the presence of GM ingredients in food is a credence attribute, which makes it impossible for consumers to judge whether a product is produced with the use of biotechnology solely based on taste and appearance (Dannenberg, Scatasta, and

Sturm 2011). In such situations, labels can act as powerful medium to convey messages (Degnan 2000), and consumers may use such information to express their true preferences (Dannenberg, Scatasta, and Sturm 2011).

FDA and USDA strictly regulate food labels (Roe and Teisl 2007) because the information provided on the labels could influence the WTP of consumers (Bredahl 2001; James and Burton 2003; Gaskell et al. 1999; Kimenju and DeGroote 2008; Rousu et al. 2007). An increase in WTP was observed for GM potatoes compared to conventional potatoes when scientific information was provided but there was no significant difference in WTP when scientific information was not provided (McFadden and Huffman 2017). Liaukonyte et al. (2013) conducted research on WTP for food labels and found differences in consumers' WTP for "Contains X" and "Free of X" Labels. Labels that stated "Contains X" had a negative impact on WTP (Liaukonyte et al. 2013). Lewis, Grebitus and Nayga (2016) examined consumer WTP for GM labels through a choice experiment and observed higher preferences for "non-GM labeled" sugar compared to no labels or "GM labeled" sugar. A valuation experiment conducted by Huffman et al. (2003) observed a lower WTP for food with GM labels compared to the food with standard food labels.

Research on the efficacy of nutritional labels suggests that consumers are more responsive to information on the front of labels compared to information on the side or back. Becker et al. (2015) conducted high-resolution eye tracking research to examine the attention paid to front of pack (FOP) labels and nutrition facts panel (NFP). The research

showed that consumers were more responsive to the FOP labels mainly because of color and label placement (Becker et al. 2015). Graham, Heidrick, and Hodgin (2015) also measure participants' attention through high-resolution eye tracking methods. Participants saw food packages with and without FOP labels and the study found that FOP labels were more effective in attracting consumers' attention than NFP, which are located on the back or side of the product. Other research has also compared FOP and NFP labels, and found that the simplified FOP information was favored and understood well by the consumers (Grunert and Wills 2007; Van Kleef et al. 2008; Alexander and Hazel 2008; Feunekes et al. 2008; Ducrot et al. 2015). Crosetto et al. (2016) showed that the benefits of FOP labels are especially pronounced in an experiment in which participants made food choices under a time constraint compared to no time constraint, a condition that likely reflects real world shopping conditions.

# CHAPTER 3: METHODOLOGY

## 3.1. Experimental process

Shoppers from two Lincoln, NE grocery stores were recruited during March and April of 2017 to participate in a valuation experiment built on the Becker-DeGroot-Marschak (BDM) mechanism (Becker et al. 1964). Upon entering the store, shoppers were approached about participating in the research in return for a $10 store gift card as compensation for their time. A total of 300 shoppers, aged 19 years and older, participated in the project. Prior to the experiment, a detailed explanation of the auction mechanism was given and a practice round was executed (See Appendix A). At the end of the experiment, participants completed a survey (Appendix B) collecting information on demographic characteristics, knowledge, and general attitudes towards GM foods. Participants took 10-15 minutes on average to complete the experiment and the survey.

The experiment was structured so that each participant completed six valuation rounds. Participants examined and submitted bids on two similar products within each round, one of which was labeled as containing GM ingredients, while the other product was not labeled as containing GM ingredients. Each participant bid on two pairs of cereals, two pairs of chips, and two pairs of cookies.[2] We used four types of branded cereals, four types of branded chips, and four types of non-branded cookies baked in-store in our experiment (Table 1). Participants were randomly placed in a "front" label condition or a "back" label condition, which determined the location of the GM information. The placement of the food product (left/right) on the computer screen was randomized to prevent order effects on WTP. A prompt question after round three asked participants

[2] The products were chosen based on the availability in the stores and were among frequently sold items.

which food product in the previous round contained GM ingredients. We included the prompt question to examine whether participants noticed the GM labels under normal evaluation conditions, and to induce search for information about GM ingredients in rounds 4 through 6. After completion of the survey, the computer randomly selected the binding round, item, and price and displayed the item and the bid price for that round.[3]

### 3.2 BDM Auction Mechanism

The BDM (Becker et al., 1964) is a widely accepted method for collecting WTP data. In the BDM, the participant submits a bid representing their maximum WTP, which is independent of the price they actually pay. A random number generated from a specified distribution gives the "random offer price" that determines the actual payment. If the participant's bid exceeds this "random offer price", they buy the product at the random price. If the bidding price is lower than the "random offer price", the participant buys nothing. BDM auctions have been used in various WTP studies (see, for example, Ginon et al. 2009; Corrigan and Rousu 2011; Vecchio and Annunziata 2015; Seppa et al. 2015).

The Vickrey auction (Vickrey 1961) and BDM are among the most popular methods to elicit information on valuation. Both give an economic incentive for the participants to consider their true WTP, where the weakly dominant strategy would be to reveal their true valuations. However, they differ in determining the price for the item in the experiment. The prices are endogenously determined in the Vickrey auction, whereas in

[3] The computer randomly draws the binding round from any of the six valuation round we had in our experiment. . The use of binding round in the experiment forces participants to elicit their true WTP in every rounds, since computer can select any valuation rounds to bind the participants' WTP.

the BDM, prices are randomly drawn from a particular distribution. The determination of the price in the Vickery auction requires a group setting, which is not practical for individuals shopping at grocery stores, considering other demands on their time and attention. From an experimenter's point of view, it is not possible to form such groups at grocery stores. The BDM auction can be conducted on individual basis, and this feature of the BDM auction proved to be more useful in the current experiment.

### 3.3 Within and Between Subject designs

The valuation experiment has both within-subject and between-subject elements. In the within subject element, all participants are exposed to every treatment, which provides more control of extraneous variables but may lead to practice and order effects. In the between subject element, participants are exposed to only one label placement treatment, reflecting what consumers would encounter in the real-world (i.e., labels will only be placed on the back or on the front of the package).

We have used within and between subject elements to study how consumer valuation was affected by the presence of labels on FOP or BOP showing that one product has GM ingredients. The within-subject aspect of the experiment was that all participants were presented with related GM and non-GM cereals, cookies, and chips. In the between-subject aspect, each participant saw the GM food label applied to one pair of cereals (whole wheat vs. whole wheat flakes and toasted oats vs. toasted oat grains), chips (potato chips vs. flavored potato chips and thin sliced potato chips vs. flavored thin sliced potato chips), and cookies (chocolate chip vs. snicker doodle and peanut butter vs. sugar

cookies). Participants only saw either the GM FOP or GM BOP food label throughout the experiment.

The participants were placed in the FOP and BOP labels scenarios to examine the effects of label placement on their valuation of these products. Half of the participants saw the products with GM ingredients on the computer-based "front" label of the package, while the other half of the participants saw the products with GM ingredients on the computer-based "back" label on the package. Only one product in each pair of products contained a GM label. We tested for differences in WTP in FOP and BOP conditions.

# CHAPTER 4: DATA MODELING AND RESULTS

## *4.1. Participant Demographics*

Table 6.2 summarizes the demographic variables of the participant sample. Women comprised 48% of the sample, which is slightly lower than the percentage of females in Lincoln, NE in 2015 of 49.9% (American Community Survey 2015). The mean age of participants (38.93 years old) was slightly higher than the mean age in Lincoln, Nebraska (35.5 years) (American Community Survey 2015), which could be due in part to an exclusion criterion that participants needed to be at least 19 years of age. The average household income was $57,470, which is slightly higher than the average household income in Lincoln of $51,503 (American Community Survey 2015). For those 25 years or older, 52.67% (138 out of 262) of the participants had a bachelor's degree or higher compared to 37.1% in Lincoln, NE who had bachelor's degree (American Community Survey 2015). In our sample, 71.3% (214 out of 300) of the participants were the primary shopper for their household.

## *4.2. Models*

Table 6.3 presents the average WTP for all front labels, all back labels and all no labels in each product type (i.e. cereals, cookies, chips), whereas, front, back and no labels in each product category were summed together and averaged to get a combined WTP for that product category. In other words, the WTP for front labels, back labels, and no labels for the chips were summed together and averaged to get a combined WTP for chips. The table provides the differences in WTP for each product category as well as for different label types (i.e. front vs. back).

We estimated our regression model using a random effects estimator. A Hausman test was performed, which confirmed that a random effects model is appropriate for our sample. The generalized least squares (GLS) random effects estimator was used to obtain parameter estimates for our model. Previous research has used GLS random effects regression to measure WTP (See, for example, Cicia and Colantuoni 2010; Carlsson and Martinsson 2001; Loehman and Hu 2014; Leung et al. 2015; Hilger et al. 2015). The GLS model accounts for heteroscedasticity, which increases the reliability of the coefficients calculated for random effects (Reinel, 1982). In our models, participants' WTP was the dependent variable. Processed food items, i.e. cookies, cereals, and chips, were included as regressors to compare the participants' WTP for food labels.

The first objective is to evaluate the effects of information placement on consumer product valuation. Therefore, the regression model takes the following form:

(4.2.1) ) $WTP_{ijk} = \beta_0 + \beta_1 Front_{ijk} + \beta_2 Back_{ijk} + \beta_3 Chips_{ik} + \beta_4 Cookies_{ik} + \beta_5 AfterPrompt_{ij} + \beta_6 Round_k + \varepsilon_{ijk}$

Equation 4.2.1 states the WTP by individual *i* for product *j* in round *k*; $\beta_0$ is the intercept (i.e. the WTP if all other independent variables are zero); *Front* is a variable equal to 1 if the GM label is placed on the front side of product and 0 otherwise; *Back* is a variable equal to 1 if the GM label is placed on the back of product and 0 otherwise. In combination, the *Front* and *Back* variables, compare participants' WTP for products containing front and back labels with products containing no labels. *Chips* is equal to 1 if

the product is chips, 0 otherwise; *Cookies* is equal to 1 if the product is cookies, 0 otherwise. *Cereal* is omitted to avoid perfect multicollinearity. *AfterPrompt* captures the prompt question[4] asked after the 3rd round where the last three rounds equal 1, 0 Otherwise. *Round* is a continuous variable that represents the valuation rounds; ε is the random error term.

Table 6.4 reports the econometric results of participants' WTP for the cereals, cookies and chips. Cookies and cereal were included in the model to control for difference in preference for product type and size. When compared to cereals, participants on average are willing to pay $2.15 less for cookies and $0.74 less for chips. These are as expected when comparing actual store prices and the differences in product size. No differences in WTP were observed for products containing the GM label on either the FOP or the BOP compared to products that had no label. Only 67 out of 300 respondents correctly answered the prompt question that was asked after the third round. The *AfterPrompt* effect was significant and on average WTP decreased by $0.27 for the last three rounds compared to the first three rounds. This could be due to the fact that the signal alerted consumers of the potential for GM containing products and they responded with lower bids in rounds 4 through 6.

Kahan et al. (2007, 2009), and Nayga, Aiew, and Nichols (2004) report that consumers' characteristics, perceptions, and attitudes influence their buying habits. Teisl, Fein, and Levy (2009) and Saher, Lindeman, and Hursti, (2006) showed that consumers' knowledge about GMOs shapes their attitudes towards the technology. Nayga,

[4] Participants were asked a prompt question to inform that our experiment may contains GM ingredients

Drichoutis, and Lazaridis (2006), conducted a review of the literature on individual characteristics and food labels. Their literature review found food label users and primary household shopper were positively associated whereas age, income and gender had mixed impacts on food label usage. Based on this framework, to address our second objectives, the information from the survey was used to analyze the relationship between the participant characteristics and their WTP. The regression was estimated with random effects. Table 6.5 displays the details of the of the regression results. The model takes the following form:

$$(4.2.2)\ WTP_{ijk} = \beta_0 + \beta_1 Front_{ijk} + \beta_2 Back_{ijk} + \beta_3 Chips_{ik} + \beta_4 Cookies_{ik} + \beta_5 AfterPrompt_{ij} + \beta_6 Round_k + \beta_7 Age_i + \beta_8 Income_i + \beta_9 Edu_i + \beta_{10} Gender_i + \beta_{11} PRIMSHOP_i + \beta_{12} Quiz_i + \beta_{13} KnowGMO_i + \beta_{14} BuyGMO_i + \beta_{15} NutriIngredients_i + \beta_{16} BuyOrganic_i + \varepsilon_{ijk}$$

where $\beta_0$ is the intercept term, *Age* is a continuous variable representing a participant's age; *Gender* is equal to 1 if a participant is female, 0 otherwise; and *INCOME* represents participant's household income. The categorical income[5] variable was converted to a numeric variable using the midpoint of each income category; *EDU i*s a variable equal to 1 if the participant had completed a bachelor's degree or higher, and 0 otherwise*;* *PRIMSHOP* is equal to 1 if the participant is the primary shopper for food in their household and 0 otherwise; and *QUIZ* is the test that measure participants' objective knowledge on GMOs. A total of 16 objective questions related to GMOs were asked. A

[5] Income was categorized as (less than $20,000; $20,000-$39.999; $40,000-$59,999; $60,000-$79,999; $80,000-$99,000; $100,000 and above.

point was given for every correct answer. The Quiz variable was normalized[6] on a scale from 0 to 1. *KnowGMO* is perceived knowledge about GMOs on a five-point scale ranging from very unknowledgeable to very knowledgeable. Very knowledgeable and somewhat knowledgeable were grouped together and treated as variable equal to 1, whereas the remaining choices were condensed to 0. *BuyGMO* is equal to 1 if participant stated they purchased GMO, 0 otherwise; *BuyOrganic* is equal to 1 if participant stated they purchased organic food, 0 otherwise; and *NutriIngredients* is equal to 1 if participant stated that they read nutrition and ingredient labels; 0 otherwise. *BuyGMO, NutriIngredients* and *BuyOrganic* had a range from {Always - (every time I shop), Frequently - (approximately 3 out of every 4 times I shop), Occasionally - (approximately 2 out of every 4 times I shop), Rarely – (approximately 1 out of every 4 times I shop), Never, and I don't know}. Always, frequently (approximately 3 out of every 4 times) and occasionally (approximately 2 out of every 4 times) were condensed to 1 while the remaining choices were given a value of 0; ε is the random error term.

The *Chips, Cookies, EDU, KnowGMO* and the *NutriIngredients* variables were found to be significant at the 1% significance level. Participants having bachelor's degrees or higher were willing to pay $0.10 less for the food products (chips, cookies and cereals) than participants without a bachelor's degree. Those participants who perceived themselves as knowledgeable about GMOs were willing to pay $0.11 less for the food products than participants who perceived themselves as unknowledgeable about GMO. On average, participants reading nutrition and ingredient labels for the first time when purchasing a product were willing to pay $0.10 more for the food products than

[6] Total number of right answer were divided by total number of questions

participants who do not read nutrition and ingredient labels. *PRIMSHOP* was significant at 5% whereas *AfterPrompt* and *Quiz* were significant at 10% level. On average, primary shoppers were willing to pay $0.10 less for the food products than non-primary shoppers. Moreover, the WTP decreased on average by $0.22 for the rounds after the prompt question, whereas we observed a negative relationship between Quiz and WTP. Participants that answered all the questions correctly on a Quiz were willing to pay $0.25 less on average than participants that incorrectly answered all the questions.

# CHAPTER 5: DISCUSSION AND CONCLUSION

In this study, we conducted a valuation experiment to determine consumer WTP for GM food labels. In each of six rounds, participants bid on two products, resulting in bids on a total of 12 items. Each round included a pair of closely related products, one of which was GM-free, while the other one contained a GM ingredient. Our experiment included both within and between subject elements. Participants were presented with choices between related GM and Non-GM products (i.e. cereals, cookies, and chips) for within subject treatment. In the between-subject treatment each participant saw the GM food label applied to one type of related product of cereals, chips, and cookies. The product that contained a GM ingredient either had a front label or a back label. Each participant was randomly placed in a front label or back label condition; therefore, they would have access to the GM information only on the front or the back of a product for all rounds.

Although we did not observe significant differences in WTP between FOP and BOP GM food labels, we found a decrease in WTP after the prompt, a question that was asked to the participants after the third round. Only 67 out of 300 participants correctly answered the prompt question. On average, the WTP decreased by $0.22 in the last three rounds compared to the first three rounds. This could be due to the fact that the prompt questioned notified consumers of the potential presence of GM containing products. This result may have indicated a signaling effect because the WTP dropped after we notified participants about GMOs; therefore, further analysis will be conducted on participants' WTP for GM foods (front and back) in the first three rounds and WTP for GM foods (front and back) in the last three rounds.

Some of the consumers' characteristics in our research were significant, a result similar to previous studies (see, for example, literature reviews done by Nayga, Drichoutis, and Lazaridis 2006). Education, primary shoppers, perceived knowledge on GMOs, Quiz (test of objective knowledge on GMOs) had an effect on consumers' WTP. Thirty-five percent (105 out of 300) of the sample perceived themselves as knowledgeable on GMOs compared to other food shoppers whereas 42% (125 out of 300) believed themselves to be unknowledgeable on GMOs. On average, participants who considered themselves as knowledgeable were willing to pay $0.10 less for the food products than participants who considered themselves unknowledgeable. Participants' perceived knowledge as well as Quiz (actual test taken with objective knowledge on GMOs) had a negative impact on participants' WTP for the food products (chips, cookies and cereals). However, the results were opposite to the findings of Teisl, Fein, and Levy (2009), Costa-Font and Mossailos (2005), and Saher, Lindeman, and Hursti (2006). We found a negative effect of education on consumer's WTP for the food products. On average, participants with bachelor's degrees or higher were willing to pay $0.10 less. We observed a negative relationship between primary shoppers and their WTP for food products. On average, primary household shoppers were willing to pay $0.10 less for the food products than non-primary shoppers of the household.

Participants were also asked if they would use a QR code or call a toll-free phone number to obtain information on whether food products they consume contain GM ingredients. The sample showed only 29% of the participants agreed that they would use QR code to

scan products to obtain information on GM ingredients whereas only 11.6% of the participants agreed that they would call a toll-free phone number to obtain information on GM products. Some of the previous research has indicated that consumers were more responsive to FOP labels, which were understood well by consumers (see, for example Alexander and Hazel 2008; Feunekes et al. 2008; Ducrot et al. 2015) and presenting QR codes or 1-800 numbers on the back side of the product may introduce additional hurdles for consumers to access information on GM food products. Future research can be conducted to analyze the impact of QR codes and toll free numbers on consumers' WTP.

In this research, we examine consumers' valuation of food items based on placement of labels and analyzed participant characteristics to gauge their impact on WTP for the food products. Numerous studies on consumer valuation of GM products have been published yet there is little evidence collected on how consumers' valuation differs if font sizes of the labels vary. Therefore, future research can be conducted to study the impact of font size (the impact of font sizes on attention paid to labels) on consumer purchasing behavior and overall valuation of GM foods.

# CHAPTER 6: TABLES

Table 6.1: Food Products used in Experiment

| Product Type[a] | Description | Food Type | Average Store Price (Dollars) | Product Size |
|---|---|---|---|---|
| **Cookies** | Chocolate chip | GM[b] | 0.42 | 1 Piece |
| | Snicker doodle | Non-GM | 0.42 | 1 Piece |
| | Sugar | Non-GM | 0.42 | 1 Piece |
| | Peanut butter | GM | 0.42 | 1 Piece |
| **Cereals** | Whole wheat | Non-GM | 3.98 | 29 Oz. |
| | Whole wheat flakes | GM | 3.29 | 20 Oz. |
| | Toasted oats | Non-GM | 3.88 | 12 Oz. |
| | Toasted oat grains | GM | 3.39 | 12 Oz. |
| **Chips** | Potato chips | Non-GM | 3.29 | 7.75 Oz. |
| | Flavored potato chips | GM | 3.29 | 7.75 Oz. |
| | Thin sliced potato chips | Non-GM | 3.49 | 9 Oz. |
| | Flavored thin sliced potato chips | GM | 3.49 | 9 Oz. |

[a]All cookies were non-branded store cookies, while cereals and chips were branded products.

[b]GM (Genetically Modified Ingredients)

Table 6.2: Variables and Descriptive Statistics of participants (n=300)

| Variable | Definition | Mean | Min | Max | SD |
|---|---|---|---|---|---|
| **Age** | Actual age of the participants | 38.93 | 19 | 69 | 12.93 |
| **Gender** | 1 if female; 0 otherwise | 0.48 | | | 0.5 |
| **Income**[a] | Annual household income in $1000s | 57.47 | 10 | 110 | 33.23 |
| **Education**[b] | 1 if completed bachelors degree or higher; 0 otherwise | 0.46 | | | 0.49 |
| **PRIMSHOP** | 1 if primary shopper for food; 0 otherwise | 0.71 | | | 0.45 |
| **KNOW_GMO** | 1 if participant stated they were knowledgeable about GMO [c]; 0 otherwise | 0.35 | | | 0.48 |
| **BUY_GMO** | 1 if participant purchases food containing GMO; 0 otherwise | 0.31 | | | 0.46 |
| **NUTRI_INGREDIENTS** | 1 if participant's read nutrition and ingredients food labels when buying a food products for the first time; 0 otherwise | 0.39 | | | 0.48 |
| **BUY_ORGANIC** | 1 if participant purchases organic food; 0 otherwise | 0.22 | | | 0.41 |
| **QUIZ** [d] | Quiz to test knowledge on GMO's | 0.41 | | | 0.11 |
| **QRCODE** | 1 if participant stated they would scan QR codes to obtain information on GM food products; 0 otherwise | 0.29 | | | 0.46 |
| **NUM_1800** | 1 if participant stated they call 1- 800 numbers to obtain information on GM food products; 0 otherwise | 0.12 | | | 0.32 |

[a] Categorical incomes were averaged using the average mean within a category

[c] GMOs are genetically modified organisms

[d] QUIZ is the test taken to measure participants actual knowledge on GMOs. A total of 16 questions were asked and given a point for every correct answer.

Table 6.3 Average WTP for Chips, Cookies, Cereals and Combined

| **Products** | **Front Label** | **Back Label** | **No Label** | **Combined WTP** |
|---|---|---|---|---|
| Chips | 2.33 | 2.38 | 2.33 | 2.35 |
| Cereal | 2.93 | 3.05 | 3.01 | 3.00 |
| Cookies | 0.87 | 0.8 | 0.85 | 0.84 |

Table 6.4:Regression Results WTP for Chips, Cereals and Cookies

| | **Estimate** | **Std. Error** | **P value** |
|---|---|---|---|
| (Intercept) | 2.97 | 0.07 | 0.001 |
| Round | 0.06 | 0.04 | 0.139 |
| Chips | -0.74 | 0.07 | 0.001 |
| Cookies | -2.15 | 0.04 | 0.001 |
| Back Label | 0.01 | 0.04 | 0.814 |
| Front Label | -0.02 | 0.04 | 0.618 |
| AfterPrompt | -0.27 | 0.12 | 0.020 |

Adjusted Rsq. = 0.48, n = 3596

Table 6.5: Regression Results WTP for products and participants characteristics

| | Estimate | Std. Error | P value |
|---|---|---|---|
| FRONT | -0.01 | 0.04 | 0.830 |
| BACK | 0.01 | 0.04 | 0.862 |
| COOKIES | -2.16 | 0.04 | 0.001 |
| CHIPS | -0.72 | 0.07 | 0.001 |
| Round | 0.04 | 0.04 | 0.300 |
| AfterPROMPT | -0.22 | 0.12 | 0.070 |
| AGE | 0.00 | 0.00 | 0.300 |
| GENDER | -0.02 | 0.03 | 0.617 |
| INCOME | 0.00 | 0.00 | 0.247 |
| EDU | -0.10 | 0.03 | 0.001 |
| QUIZ | -0.25 | 0.15 | 0.080 |
| PShopper | -0.10 | 0.04 | 0.014 |
| KNOW_GMO | -0.10 | 0.03 | 0.001 |
| BUY_GMO | 0.02 | 0.03 | 0.484 |
| NUTRI_INGREDIENTS | 0.10 | 0.04 | 0.001 |
| BUY_ORGANIC | -0.04 | 0.03 | 0.249 |
| Constant | 3.17 | 0.10 | 0.001 |

Adjusted Rsq. = 0.48, n = 3596

## REFERENCES

Alexander, D., and Hazel, J. 2008. "Front-of-Pack Nutritional Labeling: Perspectives of the New Zealand Food Industry." *New Zealand Food Authority, 2008.*

Bawa, A.S., and Anilakumar, K.R. 2013. "Genetically modified foods: safety risks and public concerns-a review." *J Food Sci Technol. 50 (6): 1035–1046.*

Baertlein, L., Maler, S., Lewis, M. 2016. "Cheerios maker General Mills to label GMOs in U.S. product". Reuters. March 18, 2016. Retrieved from *http://www.reuters.com/article/us-general-mills-gmo-labeling-idUSKCN0WK2H4*

Becker M.W., Bello, N.M., Sundar R.P., Peltier C., and Bix L. 2015. "Front of pack labels enhance attention to nutrition information in novel and commercial brands." *Food Policy (56): 76–86.*

Becker, G.M., M.H. DeGroot, and J. Marschak. 1964. "Measuring Utility by a Single Response Sequential Method." *Behavioral Science, 9: 226-236.*

Bennett, A. B., Chi-Ham, C., Barrows, G., Sexton, S., and Zilberman, D. 2013. "Agricultural Biotechnology: Economics, Environment, Ethics, and the Future." *Annual review of environment and resources, 38: 249 – 279.*

Bialkova, S, Grunert, K.G., and Van Trijp, H. 2013. "Standing out in the crowd: the effect of information clutter on consumer attention for front-of-pack nutrition labels." *Food Policy, 41: 65–74.*

Bredahl, L. 2001. "Determinants of consumer attitudes and purchase intentions with regard to genetically modified foods: results of a cross-national survey."*Journal of Consumer Policy, 24 (1): 23 – 61.*

Campos, S., Doxey, J., and Hammond, D. 2011. "Nutrition labels on pre-packaged foods: a systematic review." *Pub. Health Nutr. 14(8): 1496 -1506.*

Cantor, J., Torres, A., Abrams, C., and Elbel, B. 2015. "Five Years Later: Awareness Of New York City's Calorie Labels Declined, With No Changes In Calories Purchased." *Health Aff. 34(11): 893–900.*

Carlsson, P., and Martinsson, F. 2001. "Willingness to Pay for Reduction in Air Pollution." *Environmental economics and policy studies 4,17 -27*

Cicia, G., and Colantuoni, F. 2010. "Willingness to Pay for Traceable Meat Attributes: A Meta analysis" *Int. J. Food System Dynamics 3, 252-263.*

Colson, G.J., and Huffman, W.E. 2011. "Consumers' willingness to pay for Genetically modified foods with product – enhancing nutritional attributes." *Am J Agric Econ 93 (2): 358 – 363.*

Colson, G.J., Huffman, W.E., and Rousu, M.C. 2011. "Improving the nutrient content of food through genetic modification: Evidence from experimental auctions on consumer acceptance." *Journal of Agricultural and Resource Economics, 36(2), 343-364.*

Cooke, R., and Papadaki, A. 2014. "Nutrition label use mediates the positive relationship between nutrition knowledge and attitudes towards healthy eating with dietary quality among university students in the UK." *Appetite 83:297-303.*

Corrigan, R. J., and Rousu. C. M. 2011. "Are Experimental Auctions Demand Revealing when Values are affiliated?" *American Journal of Agricultural Economics 93(2): 514 – 520.*

Costa-Font, J., and Mossialos, E. 2005. "Is dread of genetically modified food associated with the consumers' demand for information*?" Applied Economics letters, 12 (14) 2005: 859 – 863.*

Crosetto, P., Muller, L., & Ruffieux, B. (2016). Helping consumers with a front-of-pack label: Numbers or colors? Experimental comparison between Guideline Daily Amount and Traffic Light in a diet-building exercise. *Journal of Economic Psychology, 55: 30-50.*

Dannenberg, A., Scatasta, S. and Sturm, B. 2011. "Mandatory versus voluntary labelling of genetically modified food: evidence from an economic experiment." *Agricultural Economics, 42: 373–386.*

Darby, M. R., and Karni, E. 1973. "Free competition and the optimal amount of fraud." *The Journal of Law and Economics, 16(1): 67-88.*

Degnan, F.H. 2000. "Biotechnology and the food label: A legal perspective." *Food and Drug Law Journal, 55(3): 301 – 310*

Domingo, J. L., and Bordonaba, J. G. 2011. "A literature review on the safety assessment of genetically modified plants." *Environment International, 37(4): 734-742.*

Driskell J.A., Schake M.C., Detter H.A. 2008. "Using nutrition labeling as a potential tool for changing eating habits of university dining hall patrons." *J. Am. Diet. Assoc. 108(12): 71–76.*

Ducrot, P., Mejean,C., Julia, C., Kesse-Guyot, E., Touvier M., Fezeu L., Hercberg, S., and Peneau, S. 2015. "Effetiveness of Front- of – Pack Nutrition Labels in French Adults: Results from the Nutri-Net Sante Cohort Study." *PLoS ONE 10(10): e0140898.*

Feunekes, G.I., Gortemaker, I. A., Willems, A.A., Lion, R., and Kommer, M.V. 2008. "Front of pack nutrition labeling: Testing effectiveness of different nutrition labeling formats front of pack in four European countries." *Appetite 50(1): 57 -70.*

Feunekes, G. I., Gortemaker, I. A., Willems, A. A., Lion, R., Kommer, M. V., 2010. Front-of-pack nutrition labelling: Testing effectiveness of different nutrition labelling formats front-of-pack in four European countries. *Appetite, 50(1), 57-70.*

Gaskell, G., Bauer, M.W., Durant, J. and Allum, N.C. 1999. "Worlds Apart: The Receptions of GM Foods in Europe and the United States." *Science, 285(5426): 384–387.*

Ginon, E., Loheac, Y., Martin, C., Combris, P., and Issanchou, S., 2009. "Effects of fibre information on consumer willingness to pay for French baguettes*." Food Quality and Preference, 20: 343–352.*

Godwin, S., Speller-Henderson, L., and Thompson, C. 2006. "Evaluating the nutrition label: its use in and impact on purchasing decisions by consumers." *Journal of Food Distribution Research, 37(1), 76.*

Graham D.J., Orquin J.L., and Visschers V.H.M. 2012. "Eye tracking and nutrition label use: A review of the literature and recommendations for label enhancement." *Food Policy: 78–82.*

Graham. D.J., Heidrick. C., Hodgin, K. 2015. "Nutrition Label Viewing during Food - Selection Task: Front-of-Package Labels vs. Nutrition Facts Labels."*Journal of Academy of Nutrition and Diet, 115(10): 1636 – 1646.*

Grunert, K. G., Wills, J.M. 2007. "A review of European research on consumer response to nutrition information on food labels." *Journal of public health, 15 (5): 385 – 399.*

Grunert, K.G., Wills, J.M., Fernandez – Celemin, L. 2010. "Nutrition knowledge, and use and understanding of nutrition information on food labels among consumer in the UK." *Appetite 55 (2): 177-189.*

Hallman. W.K., Cuite, C.L., Morin., X.K. 2013. "Public Perceptions of Labeling Genetically Modified Foods." *Rutgers School of environmental and biological sciences. Working Paper 2013-01.*

Hausman, J. 1978. "Specification Tests in Econometrics." *Econometrica, 46, 1251-1271*

Hawley, K.L., Roberto, C.A., Bragg, M.A, Liu, P.J., Schwartz, M.B., and Brownell, K.D. 2012. "The science on front-of-package food labels." *Pub Health Nutr. 16(3):430 – 439.*

Hilger, J., Hallstein, E., Stevens, A., and Villas-Boas, S.B. 2015. "Measuring Willingness to Pay for Environmental Attributes in Seafood." *Department of Agriculture and Resource Economics, UCB.* Retrieved from *http://escholarship.org/uc/item/6nh0g7fg*

Hodgkins, C., Barnett, J., Wasowicz-Kirylo, G., Stysko-Kunkowska, M., Gulcan, Y., Kustepeli, Y., Akgungor,S., Chryssochoidis,G., Fernandez – Celemin, L., Storcksdieck genannt Bonsmann, S., Gibbs, M., and Raats, M. 2012. Understanding how consumers categorize nutritional labels: a consumer derived typology for front-of-pack nutrition labels. *Appetite. 59(3):806 – 817.*

Hossain, F. and B. Onyango,B. 2004. Product attributes and consumer acceptance of nutritionally enhanced genetically modified foods. *International Journal of Consumer Studies, 28(3), 255 - 267*

Huang, L., and Lu, J. 2015. "Eat with your eyes: Package color influences the expectation of food taste and healthiness moderated by external eating." *The Marketing Management Journal, 2, 71 – 87.*

Huang, J., Qiu, H., Bai, J and Pray, C. 2006. "Awareness, acceptance of and willingness to buy genetically modified foods in Urban China." *Appetite 46, 144 -151.*

Huffman, W. E., Shogren, J. F., Rousu, M., and Tegene, A. 2003. "Consumer willingness to pay for genetically modified food labels in a market with diverse information: Evidence from experimental auctions." *Journal of Agricultural and Resource Economics: 481-502.*

James, C. 2015. "Global Status of Commercialized Biotech/GM Crops: 2015." *International Service for the Acquisition of Agri-biotech Applications. Ithaca, NY.*

James, S. and M. Burton .2003. "Consumer Preferences for GM Food and other Attributes of the Food System." *Australian Journal of Agricultural and Resource Economics, 47(4): 501-518.*

Just Label It. 2017. "Home page." Accessed August 2, 2017 at http://www.justlabelit.org/

Kahan, D.M., Braman, D., Slovic, P., Gastil, J. and Cohen, G., 2009b. "Cultural Cognition of the Risks and Benefits of Nanotechnology." *Nature Nanotechnology, 4(2): 87-90.*

Kahan, D.M., Slovic, P., Braman, D., Gastil, J. and Cohen, G.L. 2007. "Affect, Values, and Nanotechnology Risk Perceptions: An Experimental Investigation." *Cultural Cognition Working Paper 22. Available at (http://papers.ssrn.com/sol3/papers.cfm?abstract_id=968652)*

Katarzyna, S. H., Pantil-Kuncewicz, A., and Mieczkowska, M. 2010. Contemporary food labeling and its role in consumers' edition: International conference of food innovation. Retrieved June 25, 2012 from http://www.foodinnova.com/foodInnova/docu2/342.pdf.

Kimenju, S. C., and De Groote, H. (2008). "Consumer willingness to pay for genetically modified food in Kenya." *Agricultural economics, 38(1): 35-46.*

Leung, P., Loke, M.K., Keahiolalo, K., and Xu, X. 2015. "Local premium or local discount: the case of packaged fresh tomatoes in Hawaii." Journal of Agricultural and Applied Economics, 47(3), 345–358

Levidow, L., and Boschert, K. 2008. "Coexistence or contradiction? GM crops versus alternative agricultures in Europe." *Geoforum, 39(1): 174–190.*

Lewis, K. E., Grebitus, C., and Nayga, R. M. 2016. "US consumers' preferences for imported and genetically modified sugar: Examining policy consequentiality in a choice experiment." *Journal of Behavioral and Experimental Economics, 65: 1-8.*

Liaukonyte, J., Streletskaya, N.A., Kaiser, H.M., and Rickard, B. J. 2013. "Consumers response to "Contains" and "Free of" labeling: Evidence from Lab Experiments. *Applied Economic and Perspectives and Policy, 35(3): 476–507.*

Loehman, E., and Hu, V. 2014. "Application of Stochastic Choice Modeling to Policy Analysis of Public Goods: A Case Study of Air Quality Improvements." *The Review of Economics and Statistics,64, 474-480.*

Mackison, D., Wrieden, W. L., and Anderson, A. S. 2010. "Validity and testing of a short questionnaire developed to assess consumers' use, understanding and perception of food labels." *European Journal of Clinical Nutrition, 64(2), 210-217.*

McFadden, B. R., and Lusk, J. L. (2016). What consumers don't know about genetically modified food, and how that affects beliefs. The FASEB Journal, 30(9): 3091-3096.

McFadden, J. R., and Huffman, W.E. 2017. "Consumer valuation of information about food safety achieved using biotechnology: Evidence from new potato products." *Food policy, 69: 82 – 96.*

Montuori, P., Triassi, M., and Sarnacchiaro, P. 2012. "The consumption of genetically modified foods in Italian high school students." *Food quality and preference, 26(2): 246 – 251.*

Nayga, R. M, Drichoutis, A. C., and Lazaridis, P. 2006. Consumers' use of nutritional labels: a review of research studies and issues. *Academy of marketing science review, 2006, 1.*

Nayga, R. M. Jr., Aiew, W. and Nichols, J. P. 2004. "Information Effects on Consumers' Willingness to Purchase Irradiated Food Products." *Applied Economic Perspectives and Policy, 27(1): 37-48.*

Nelson, P. 1970. "Information and consumer behavior." *Journal of Political Economy*, *78*(2), 311-329.

Nicolia, A., Manzo, A., Veronesi, F., and Rosellini, D. 2013. "An overview of the last 10 years of genetically engineered crop safety research." *Critical Reviews in Biotechnology, Early Online: 1 – 12.*

Non-GMO Project. 2016a. "Home page." Accessed August 2, 2017 at https://www.nongmoproject.org/.

Non–GMO Project. 2016b. "Product Verification." Accessed August 2, 2017 at https://www.nongmoproject.org/product-verification/the-standard/.

Onyango, B., Ferdaus, H., Hallman, W., B. Schilling, B., and Adelajan, A. 2003. **"**Public Perceptions Of Food Biotechnology: Uncovering Factors Driving Consumer Acceptance Of Genetically Modified Food." *Journal of Food Distribution Research 34, 37 - 42*

Ollberding, N.J., Wolf, L.R., and Contento, I. 2010. "Food labels use and its relation to dietary intake among US adults." *J Am Diet Assoc. 110(8): 1233 – 1237.*

Osterman, C. and Penmudi, A. "ConAgra to disclose GMOs on labels throughout U.S." *Reuters. March 22,2016.* Retrieved from http://www.reuters.com/article/congra-gmo-idUSL2N16U2G5

Petrovici, D., Fearne, A., Nayga Jr, R. M., and Drolias, D. 2012. Nutritional knowledge, nutritional labels, and health claims on food: A study of supermarket shoppers in the South East of England. *British Food Journal, 114(6), 768-783.*

Roe, B., and Teisl, M. F. 2007. "Genetically modified food labeling: The impacts of message and messenger on consumer perceptions of labels and products." *Food Policy, 32(1): 49-66.*

Reinsel, G. 1984. "Estimation and prediction in a multivariate random effects generalized linear model." *J. Amer. Statist. Assoc. 79, 406–414.*

Rousu, M., Huffman, W. E., Shogren, J. F., and Tegene, A. 2007. "Effects and value of verifiable information in a controversial market: evidence from lab auctions of genetically modified food." *Economic Inquiry, 45(3): 409-432.*

Saher, M., Lindeman, M., and Hursti. U.K. 2006. "Attitude towards genetically modified and organic food." *Appetite 46: 324 – 331.*

Schuldt, J. P. 2013. "Does Green Mean Healthy? Nutrition Label Color Affects Perceptions of Healthfulness", *Health Communication, DOI:10.1080/10410236.2012.725270*

Sebastian-Ponce, M.I., Sanz – Valero, J., and Wanden – Berghe, C. 2014. Consumers reaction to information on the labels of genetically modified food. *Rev Saúde Pública 48 (1):154-169.*

Seppa, L., Latvala, T., Akaich, F., Gil, M.J., and Tuorila, H. 2015. "What are domestic apples worth? Hedonic responses and sensory information as drivers of willingness to pay." *Food quality and preferences, 43: 97 – 105.*

State of Vermont. 2013. "Consumer protection; food labeling; genetic engineering An act relating to the labeling of food produced with genetic engineering." Accessed August 1, 2017 at http://legislature.vermont.gov/assets/Documents/2014/Docs/ACTS/ACT120/Act120%20Act%20Summary.pdf

Teisl, M. F., Fein, S. B., and Levy, A. 2009. "Information effects on consumer attitudes toward three food technologies: organic production, biotechnology, and irradiation." *Food Quality and preference, 20 (8): 586 – 596.*

U.S. Census Bureau. 2015. "2011 – 2015 American Community Survey five year Estimates." U.S. Census Bureau – ACS Retrieved from *https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF*

U.S. Congress. 2016. "Agricultural Marketing Act of 1946 as Amended through P.L. 114-216, Title II, Subtitle E: National Bioengineered Food Disclosure Act." July 29, 2016, accessed August 2, 2017 at https://www.agriculture.senate.gov/imo/media/doc/Agricultural%20Marketing%20Act%

20Of%201946.pdf.

U.S.D.A. Agricultural Marketing Service. 2017. "USDA Seeks Input in Developing a Proposed Bioengineered Food Disclosure Rule." July 10, 2017. Accessed August 2, 2017 at https://www.ams.usda.gov/content/usda-seeks-input-developing-proposed-bioengineered-food-disclosure-rule.

Van Kleef, E., Van Trijp, H.C, Paeps, F., and Fernandez- Celemin,L. 2008. "Consumer preferences for front of pack calories labeling." *Public Health Nutrition,11 (2): 203 – 213.*

Vecchio, R., and Annunziata, A. 2015. "Willingness-to-pay for sustainability-labelled chocolate: an experimental auction approach." *Journal of Cleaner Production, 86(1): 335 – 342*

Vickrey, W. 1961. "Counterspeculation, Auctions, and Competitive Sealed Tenders." *The Journal of Finance 16(1): 8-37.*

Walters, A., and Long, M. 2012. "The effect of food label cues on perceptions of quality and purchase intentions among high- involvement consumers with varying levels of nutrition knowledge." *Journal of Nutrition Education and Behavior, 44(4), 350 – 354.*

Wunderlich, S., & Gatto, K. A. (2015). Consumer perception of genetically modified organisms and sources of information. *Advances in Nutrition, 6(6): 842-851.*

Zhang, C., Wohlhueter, R., and Zhang, H. 2016. "Genetically modified foods: A critical review of their promise and problems." *Food science and Human Wellness, 5 (3): 116 – 123.*

Zhao, S., Yue, C., Cummings, C. L., and Kuzma, J. 2015. "Investigating factors influencing consumer willingness to buy GM food and nano – food*." Journal of Nanoparticle Research 17: 1–19.*

**Appendix A: Choice Experiment & Instructions**

In this research, we are interested in the valuation of food items. You will be presented with six pairs of food items and will be asked to submit your valuation for each of the items. A short survey will follow the food valuation exercise. We would like to emphasize that your responses are completely confidential, and we will not collect any information that would allow anyone to identify you from your responses. Information collected in the experiment will be used to examine general behavior—that is, we will pool your anonymous responses with those of other anonymous participants to see how people value these items "on average."

You will soon have the opportunity to participate in a practice round that will illustrate how this works. First, though, we will consider a thought experiment to provide some intuition for thinking about your maximum willingness to pay. Imagine that you need a gallon of milk and a friend is going to a grocery store. As you normally don't shop at this store, you do not know the price of a gallon of milk there. You give money to your friend to buy a gallon of milk. If the gallon of milk costs less than the amount you provided, the friend will buy the milk and give you the change back. If the gallon of milk costs more, your friend will not buy the milk. So, your best approach is to give your friend the most you are willing to pay for the gallon of milk. That way, if the price at that store is equal to or less than your willingness to pay, you will get the gallon of milk at a price you were happy to pay. If the price is more than your willingness to pay, you will not pay more for milk than you wanted to. A numeric example is given in the table below.

Example: Willingness to pay for a gallon of milk

| Scenario | Your true willingness to pay | Money given to friend | Price of milk | Outcome |
|---|---|---|---|---|
| A | $3.50 | $4.50 | $4.25 | Pay $0.75 more than WTP |
| | | | $2.75 | Pay $0.75 less than WTP (optimal outcome) |
| B | $3.50 | $3.50 | $4.25 | Do not purchase (optimal outcome) |
| | | | $2.75 | Pay $0.75 less than WTP (optimal outcome) |
| C | $3.50 | $2.50 | $4.25 | Do not purchase (optimal outcome) |
| | | | $2.75 | Do not purchase; forego $0.75 of value ($3.50-$2.75). |

If you give your friend your true value for the gallon of milk, you guarantee an optimal outcome for yourself. On the other hand, if you give your friend more or less money than you value the milk, you risk spending more than you want to spend or missing the opportunity to purchase the milk at a price you would have been happy to pay.

Your task of valuing the food items presented to you follows this intuition. Thus, your best strategy will be to submit your true willingness to pay – "the amount of money that would just make you indifferent between buying the item and not buying the item". The willingness to pay you submit will be compared to a price the computer randomly draws to determine your outcome. At the most you would purchase only one of the items presented to you in the research. The computer will randomly select one of the items at the end of the research; your willingness to pay for the randomly selected item will be compared to the randomly drawn experiment price for that item. If your willingness to

pay is greater than the randomly drawn experiment price, you will purchase the item for the randomly drawn experiment price.

So, as part of the research today, the only way you will purchase an item is if your willingness to pay for the item is above the randomly drawn experiment price. As long as you accurately report your willingness to pay for each item in the research, you will have done everything you can to create a situation in which any potential outcome will be favorable for you. You should be in a screen that says " **Click start to begin**". We will now being your valuation practice round on the computer. Please click start.

**PRACTICE ROUND:**

Please state the maximum price that you are willing to pay for the gallon of milk. You will repeat the similar procedure for the second gallon of milk. Once you are done hit next on your computer screen. **We would like to answer or clarify any confusion that you may have before we begin our actual research.**

**FOOD VALUATION ROUND 1 – 6:**

We will begin our research now. This is the first round of the research. We also want to let you know that each of these food items represents real food items in the store. Similar to the example you will see two items. Please state the maximum price you are willing to pay for each item and then hit next. You will repeat the same procedure for 6 rounds. **Once done with the 6 rounds of valuation, Please INFORM the instruction.**

**SURVEY QUESTIONS:**

At this point, we are done with round 6. We would like you to answer a short survey that includes some opinion based, demographical and knowledge-based questions. As a reminder, all of your responses throughout the survey, as well as the experiment, are confidential. We will collect no information that would allow anyone to identify you specifically, and only average aggregate data will be reported.

**BINDING ROUND:**

Now we will randomly draw the binding round. Please see the researcher for final information and your gift card. [The computer randomly draws the binding round, item, and price]. Round x is the randomly drawn binding round, and __ was randomly selected as the product. You said that you would be willing to pay $x.xx for the item. The randomly drawn price is $y.yy. Therefore you will buy the item for $y.yy / will not buy the item. Again, thank you for participating in our research today.

**Appendix B: Survey**

**Demographic Questions**

**1. What year were you born?**

**…..……..**

**2. What is your gender?**

A. Male
B. Female

**3. What is the highest level of education you have completed?**

A. Less than high school
B. High school
C. Some college
D. 2-year college degree/associates degree
E. 4- Year college graduate (B.A., B.S.)
F. Advanced Degree (M.D., J.D., M.A., M.S., or Ph.D.)

**4. Are you the primary food shopper for your household?**

A. Yes
B. No

**5. What was your approximate annual household income before taxes in 2015?**

A. Less than $20,000
B. $20,000 - $39,999
C. $40,000 - $59,999
D. $60,000 - $79,999
E. $80,000 - $99,999
F. $100,000 or more

**Opinion Based Questions**

1. **Compared to other food shoppers, how knowledgeable would you say you are about Genetically Modified Organisms? (GMOs)**
   A. Very unknowledgeable
   B. Somewhat unknowledgeable
   C. Neither unknowledgeable nor knowledgeable
   D. Somewhat knowledgeable
   E. Very knowledgeable

2. **How often do you buy food containing genetically modified ingredients?**
   A. Always – (every time I shop)
   B. Frequently – (approximately 3 out of every 4 times I shop)
   C. Occasionally – (approximately 2 out of every 4 times I shop)
   D. Rarely – (approximately 1 out of every 4 times I shop)
   E. Never
   F. I don't know

3. **How often do you read information provided on nutrition and ingredient labels when buying a food product for the first time?**
   A. Always
   B. Frequently – (approximately 3 out of every 4 times)
   C. Occasionally – (approximately 2 out of every 4 times)
   D. Rarely – (approximately 1 out of every 4 times)
   E. Never
   F. I don't know

4. **When organic food products are available, I ____ purchase organic products?**
   A. Always
   B. Frequently – (approximately 3 out of every 4 food items)
   C. Occasionally – (approximately 2 out of every 4 food items)

D. Rarely – (approximately 1 out of every 4 food items)

E. Never

F. I don't know

5. **On a scale of 1 to 5, to what extent do you agree or disagree with the following statements? (**1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree)

| **Sources of information** | **(Scale 1 – 5)** |
|---|---|
| I seek out Scientific Research, Articles, and Journals for information on Genetically Modified foods. | |
| I seek out Governmental Agencies – (e.g., United States Department of Agriculture, Food and Drug Administration, Environmental Protection Agency, etc.) for information on Genetically Modified foods. | |
| I seek out Media – (e.g., Newspaper (print or online), Radio, TV, etc.) for information on Genetically modified foods. | |
| I seek out Social Media – (e.g. Facebook, Twitter, etc.) for information on Genetically Modified foods. | |
| I seek out Special interest groups (e.g., PETA - People for the Ethical Treatment of Animals, Non-GMO Project, etc.) for information on Genetically Modified foods. | |
| I seek out Industry groups (e.g. Corn Board, Soybean Board, Vegetable/Produce Association, etc.) for information on Genetically Modified foods | |
| I seek out Friends, Family, Relatives, and Personal Contacts for information on Genetically Modified foods. | |

6. **On a scale of 1 to 5, to what extent do you agree or disagree with the following statements? (**1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree)

| **Statement** | **Scale (1-5)** |
|---|---|
| Genetically modified foods are safe to consume. | |
| I would be upset if I consumed genetically modified ingredients unknowingly. | |
| I trust US government agencies such as the Food & Drug Administration to regulate genetically modified food labeling. | |
| Non-genetically modified foods are healthier than genetically modified foods. | |
| Genetically modified food labeling should be mandatory around the United States. | |
| Genetically modified food's potential benefits outweigh potential costs. | |

**<u>Knowledge Based Questions</u>**

**1. Which of the following crops that are currently available in the food outlets are NOT genetically modified?**

A. Corn
B. Cotton
C. Sugar Beets
D. Canola
E. Soybeans
F. Wheat

**2. Which of the following is NOT a reason that crops have been genetically modified?**

A. To be resistant to diseases

B. To reduce food waste

C. To improve traceability

D. To improve nutritional content

**3. Which of the following statements are true or false?**

| Statement | True/False |
|---|---|
| Prior to genetic modification, Corn had always contained the same genes before. | |
| Yeast for brewing beer contains living organisms. | |
| If livestock eat genetically modified grain, the meat will contain genetically modified components. | |
| Genetically modified crops are required to be tested for possible allergens. | |
| Ordinary tomatoes do not contain genes while genetically modified tomatoes do. | |
| The terms “genetically modified” and “genetically engineered” mean the same thing. | |
| Eating Genetically Modified foods could modify a person’s genes. | |

**4. In what year were genetically modified seeds first available commercially in the United States?**

A. 1984

B. 1989

C. 1996

D. 1998

E. 2004

**5. In how many countries are genetically modified crops now grown?**

A. 9

B. 18
C. 28
D. 34
E. 56

**6. How many countries have banned genetically modified crops?**

A. 19
B. 28
C. 38
D. 41
E. 52

**7. In which country are the most genetically modified crops grown?**

A. China
B. Brazil
C. Argentina
D. United States
E. Canada

**8. What is the most widely grown genetically modified crop in the United States?**

**A.** Cor**n**
B. Soybean
C. Cotton
D. Squash
E. Papayas

**9. Which of the following fruits and vegetables do not have genetically modified varieties?**

A. Sugar beets
B. Plums
C. Papayas
D. Yellow and green squash
E. Blueberries

**10. Which of the following technologies do you use? Check all that apply.**

A. Smart phones
B. Tablets
C. Smart watches
D. QR or bar code scanner applications

11. **A QR ("Quick Response") Code is a mobile phone or tablet readable barcode that consists of black squares arranged in a square grid on a white background, and they can provide more specific information about a product.**

12. **Taking into consideration the other demands on my time and attention, I would scan a QR code to check for genetically modified ingredients for a product in-store or at home.**
    A. Strongly Disagree
    B. Disagree
    C. Neither agree nor disagree
    D. Agree
    E. Strongly Agree

13. **Taking into consideration the other demands on my time and attention, I would call a 1-800 number to check for genetically modified ingredients for a product in-store or at home.**
    A. Strongly Disagree
    B. Disagree
    C. Neither agree nor disagree
    D. Agree
    E. Strongly Agree